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INT CL$^6$ F25C 1/22 , F25D 23/12
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# (54) Ice making apparatus

(57) A pump 69 inside a water supply tank 10, installed in a refrigerator, is driven in a non-contact mode (using magnets 73,80 to transmit torque) by a drive unit 72 installed outside the tank 10, in order to deliver water to an ice-making tray 27.

FIG. 2

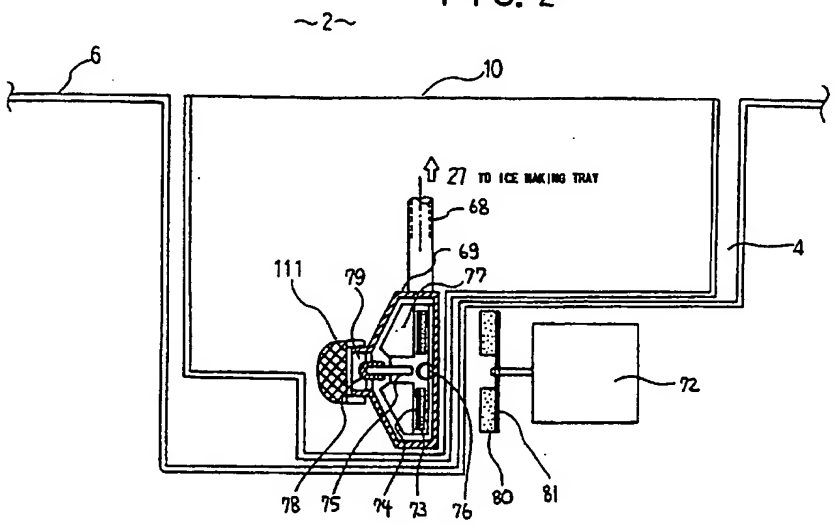




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FIG. 1

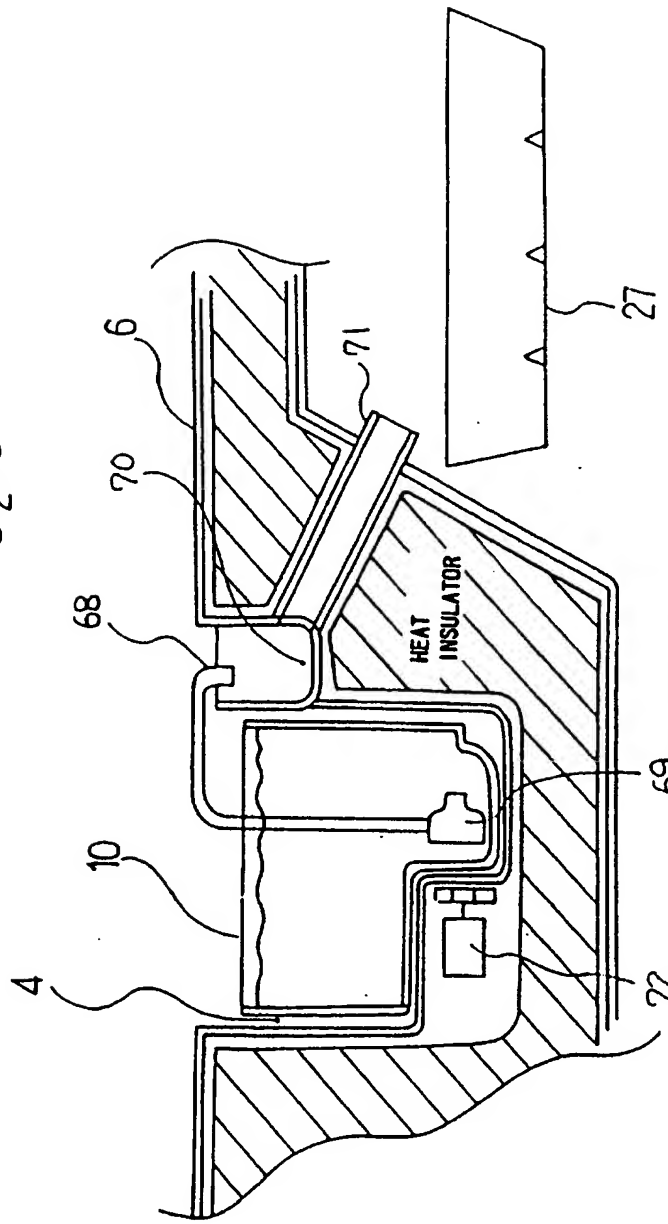


FIG. 2

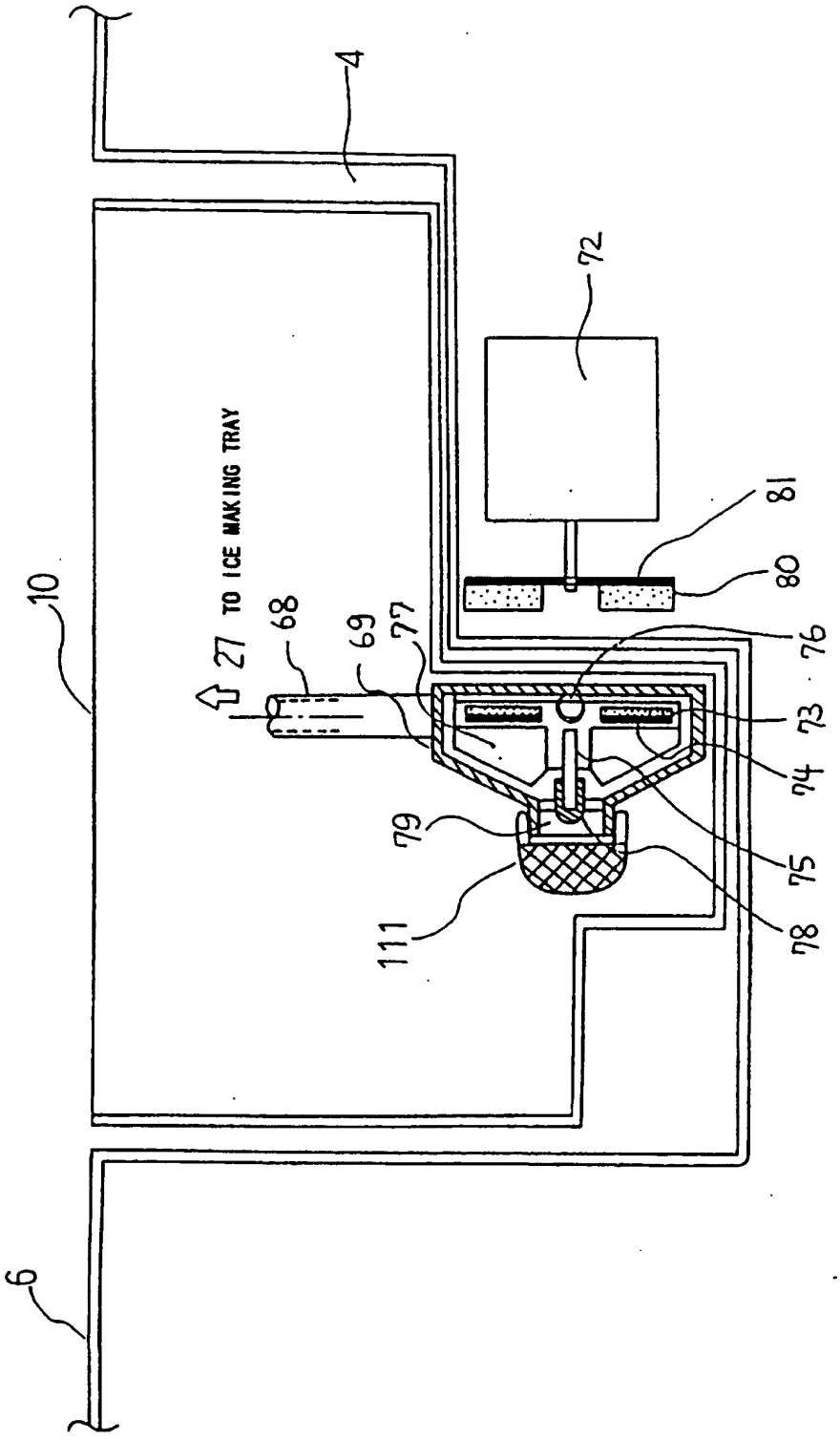


FIG. 3A

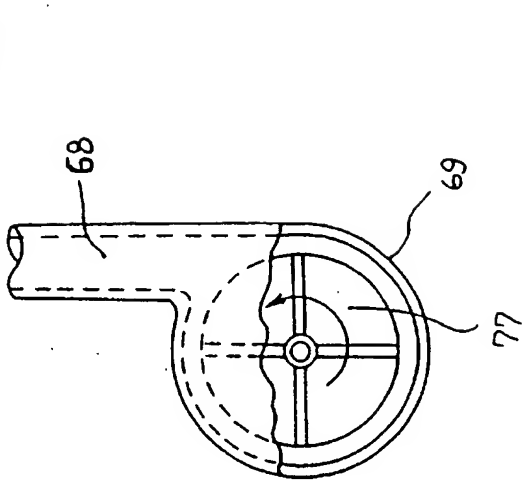



FIG. 3B

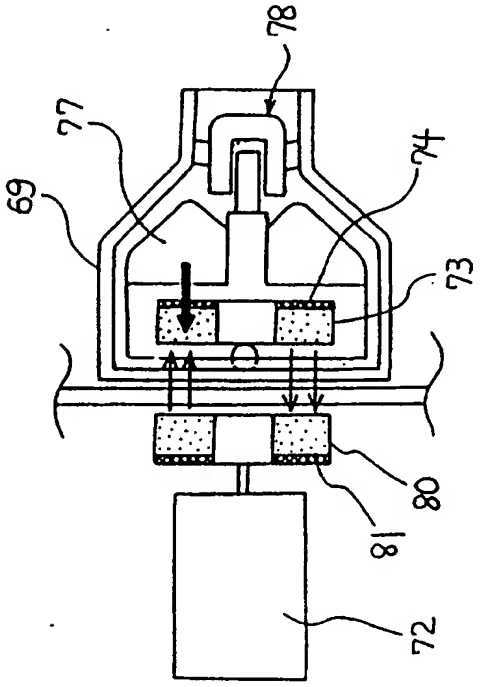



FIG. 3C

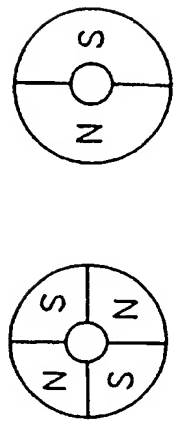


FIG. 4

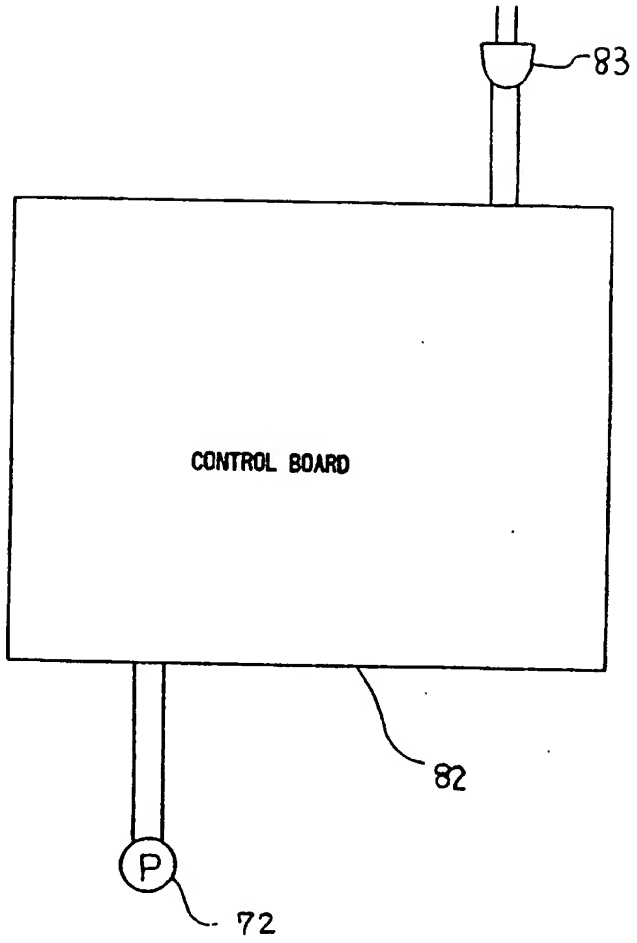


FIG. 5

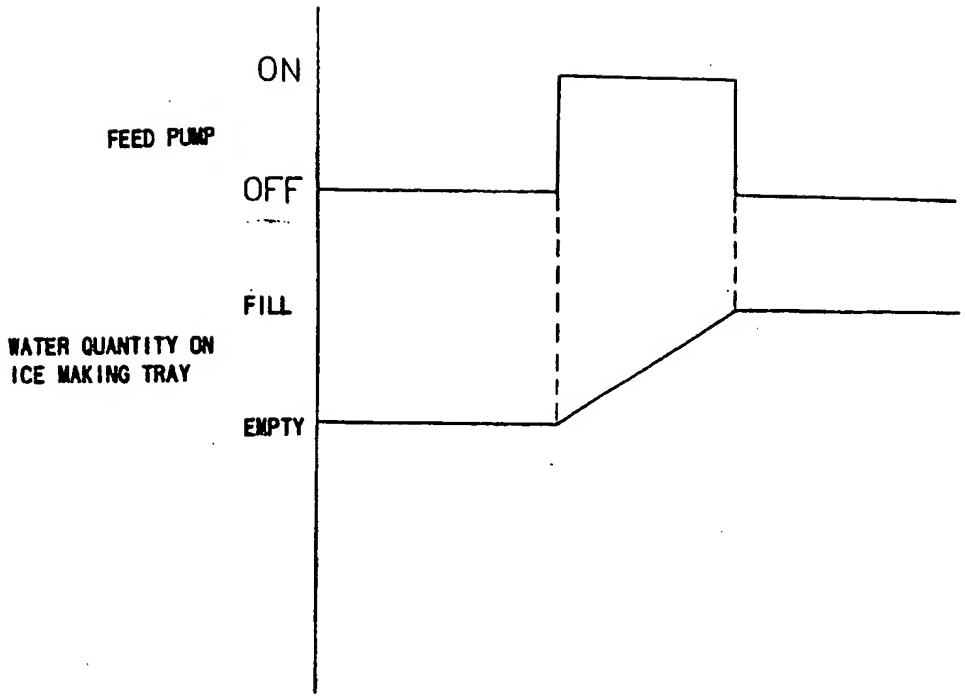

ON
FEED PUMP
OFF
FILL
WATER QUANTITY ON ICE MAKING TRAY
EMPTY

FIG. 6

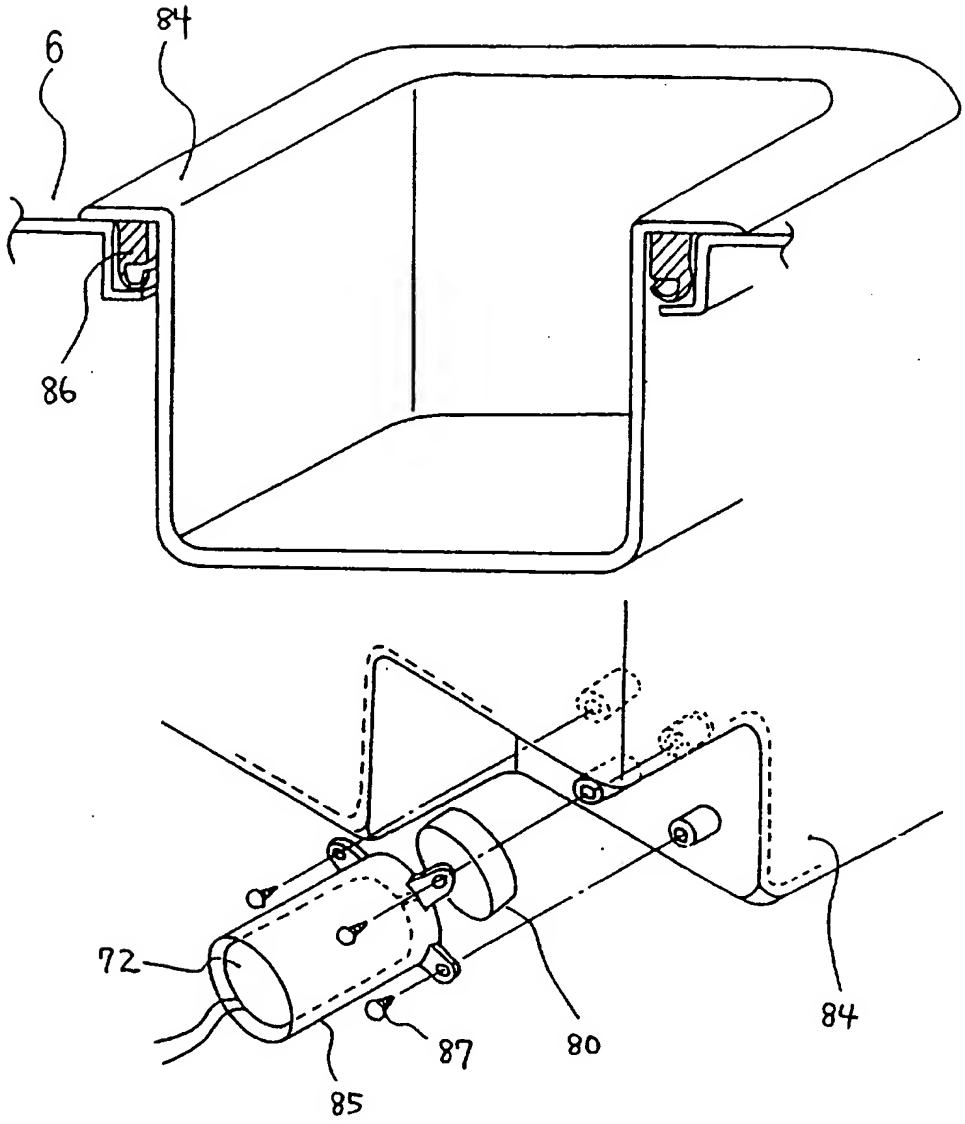


FIG. 7

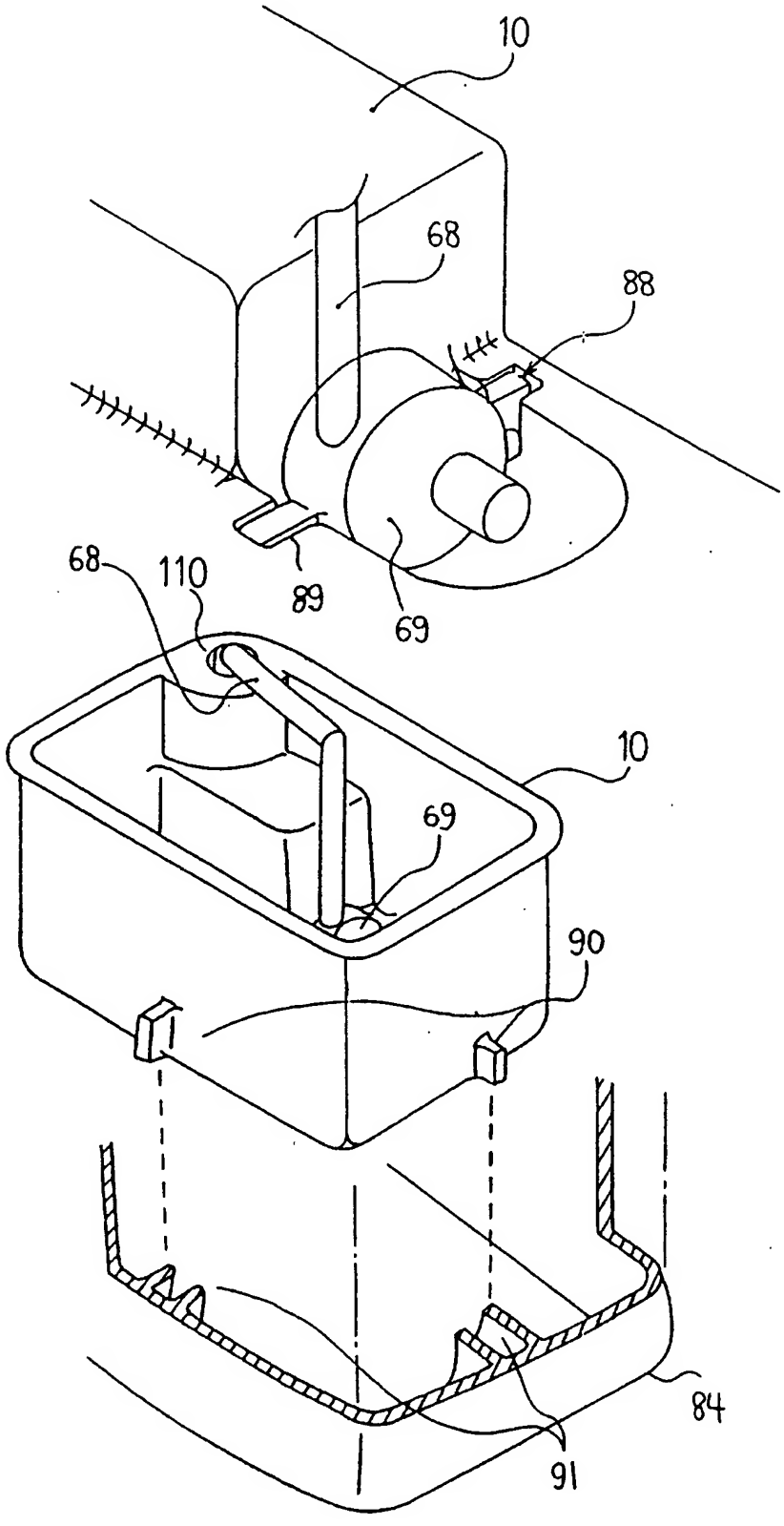


FIG. 8

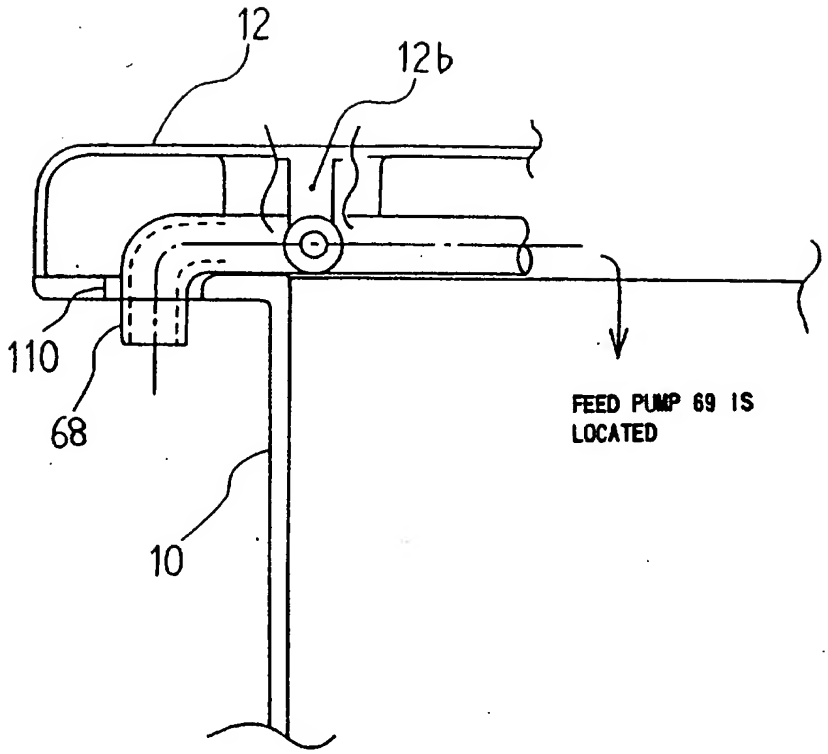


FIG. 9

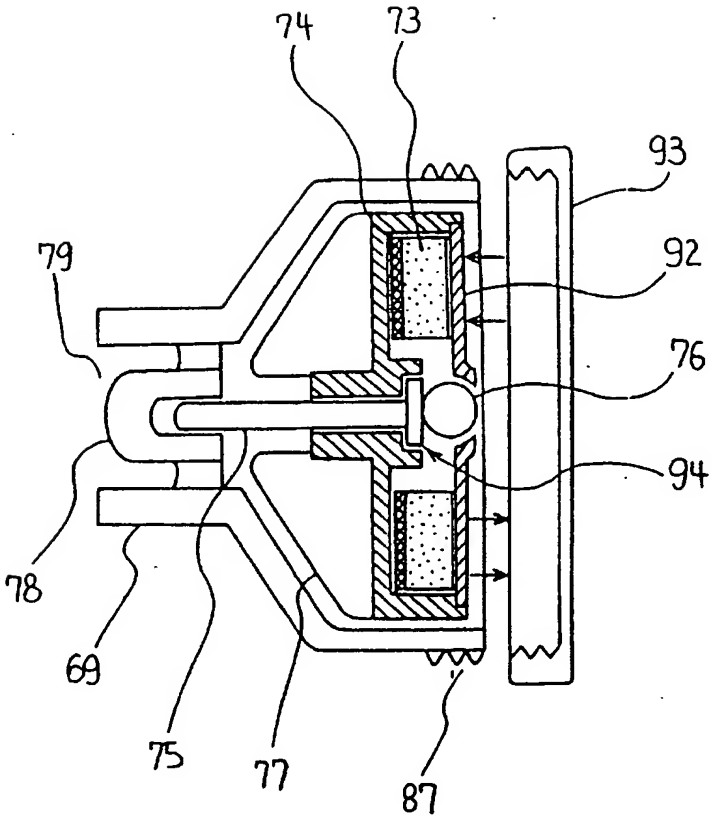


FIG. 10

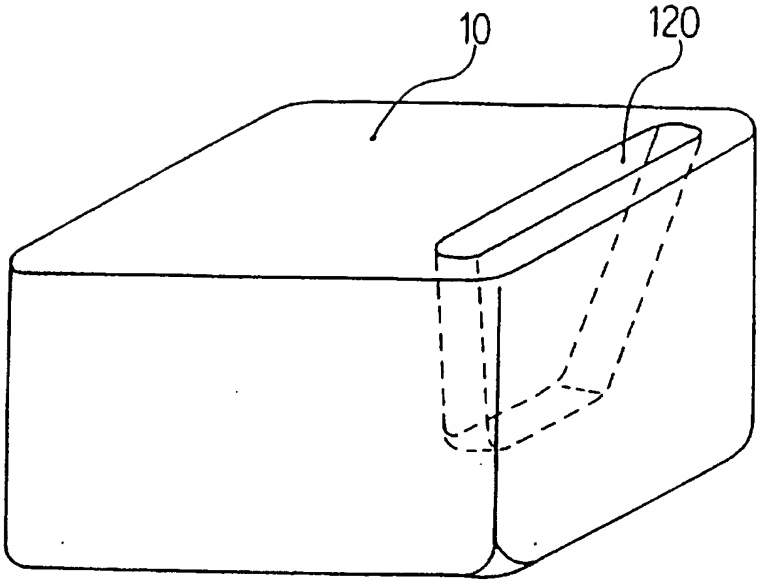



FIG. 11

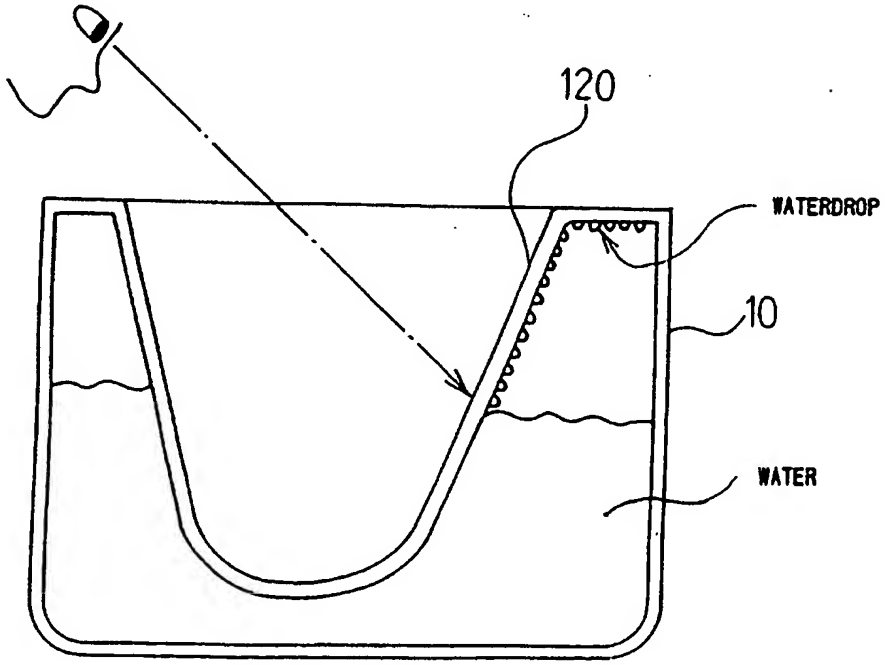


FIG. 12

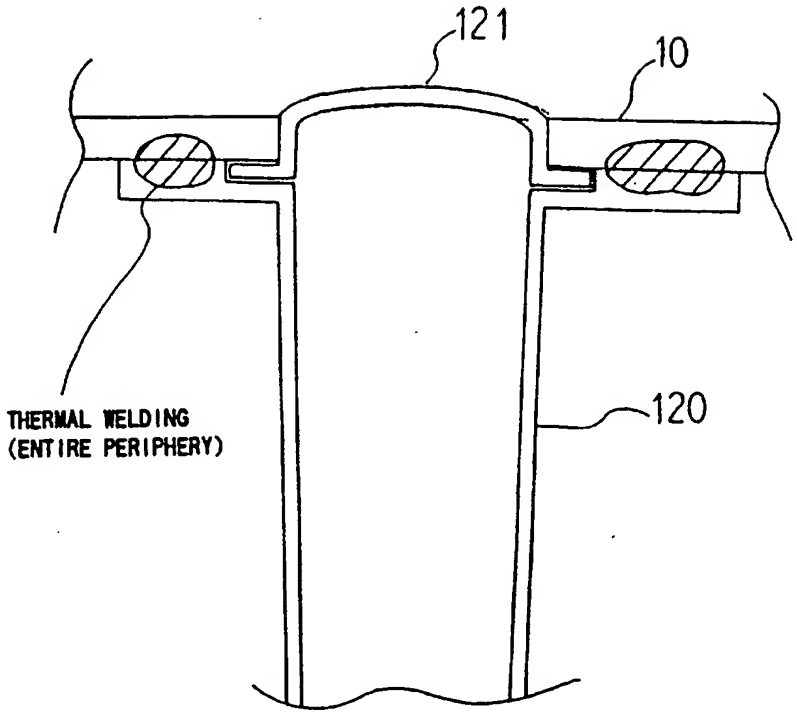



FIG. 13

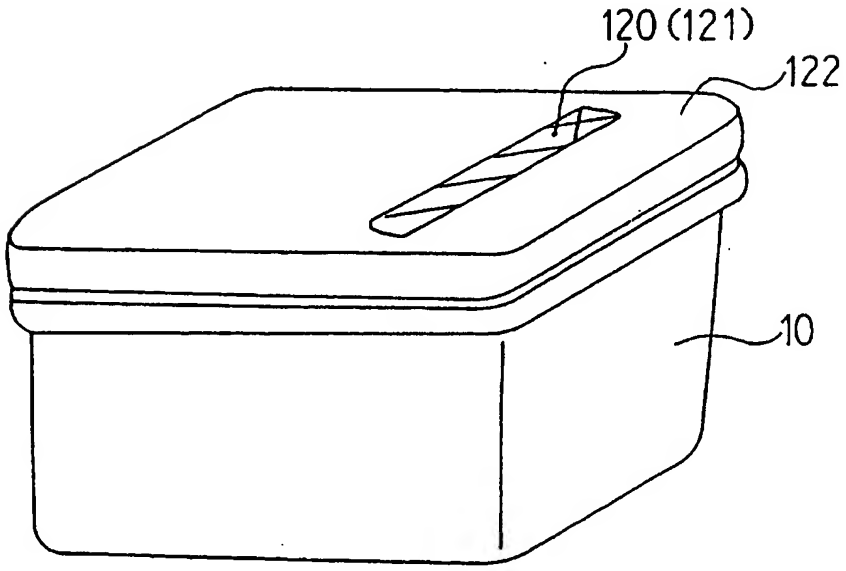


FIG. 14

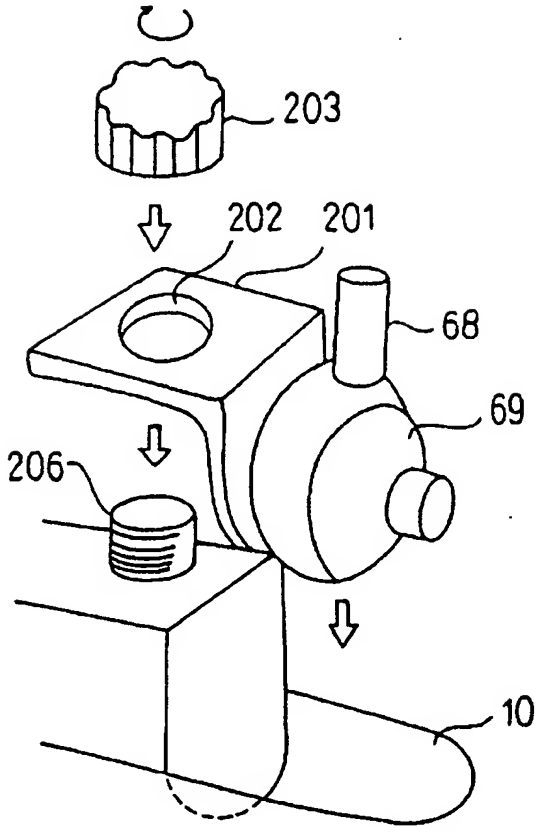


FIG. 15

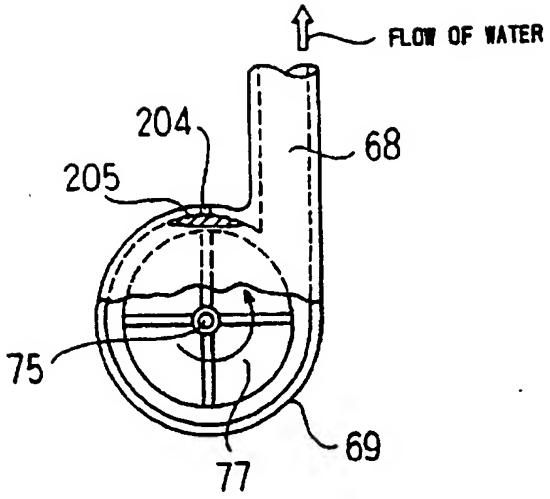
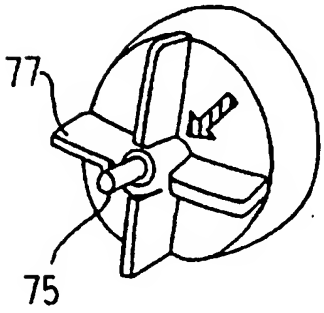



FIG. 16



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# AUTOMATIC ICE MAKING APPARATUS IN A REFRIGERATOR

The present invention relates to automatic ice making apparatus for supplying water to an ice making tray and producing ice in a refrigerator.

The present invention provides an automatic ice making apparatus comprising:

a water supply tank installed in a refrigerator;

a pump installed within the water supply tank for discharging water stored in the water supply tank into an ice making tray; and

a drive unit installed outside the water supply tank, for driving the pump;

wherein the drive unit delivers torque for driving the pump in a non-contact mode.

Thus, a user can freely wash almost all the paths for water supply including the feed pump, and as far as electrical and structural aspects are concerned, the motor of the drive unit has no connection with the pump, and for this reason safety and silence of the motor can be achieved.

A torque is delivered by providing a magnet in the pump and also providing another magnet in the drive unit at a position opposite to the

magnet provided in the pump, so that a motor and a feed pump can be constructed in a non-contact mode, and a safe and high-reliability device can be achieved.

The drive unit may be attached to a tank supporting means provided on a wall of the refrigerator or in the refrigerator for mounting thereon the water supply tank, having no connection with the water supply tank through water, so that, because the motor is fixed to a tank holder so that no water around the water supply tank reaches the motor, which is an electrical component, positioning between the motor and the water supply tank can precisely and easily be achieved.

A water receiving section may be provided between the water supply tank and the ice making tray, and a discharge port of a discharge pipe connected to the pump for discharging water into the water receiving section is located above the maximum water level within the water supply tank as well as under an upper edge section of the water receiving section, so that water runs out at the edge of the discharge port when the feed pump is stopped, and at the same time water does not overflow out of the water receiving section.

A movable section of the pump may be removably provided in a casing which is an enclosure for accommodating the movable section of the pump therein, so that a user can clean even the internal section of a feed pump.

A filter may be removably provided on a pump suction port provided in the water supply tank, so that such foreign bodies that may block the impeller section can be prevented from reaching the impeller section, and the filter section can be cleaned.

The apparatus may comprise tank supporting means provided on a wall of the refrigerator or in the refrigerator for mounting the water supply tank thereon, and positioning means for fixing the position of the water supply tank in three directions by partially contacting the water supply tank, so that a step-out phenomenon of a magnet does not easily occur.

One end of a rotary shaft of the pump may be rotatably supported by a pump bearing with the other end rotatably supported by an impeller, so that the number of components when disassembled can be decreased.

A water level display window enabling visual check of a water level in the water supply tank may be provided in an upper section of the water

supply tank, so that, even if water drops are adhered to the wall surface of the water supply tank, a user can check a water level at a boundary section between a group of water drops and the water.

A positioning means for positioning in the thrust direction as well as in the radial direction may be provided in an L-shaped angle monolithically provided on the feed pump, and an engaging section for engaging and fixing the positioning means is provided on a water supply tank, so that the feed pump can closely be fixed to the water supply tank.

An air-vent hole having a diameter which is substantially the same as that of a discharge port may be provided in an upper section of a casing for the feed pump at a position in a rotated direction from the discharge port, so that fluctuation of a water flow rate due to presence of air is eliminated and the water supply rate is stabilized.

Preferred and optional features of this invention will become understood from the following description with reference to the accompanying drawings, in which:

Fig. 1 is a cross-sectional view showing an automatic ice making apparatus according to Embodiment 1 of the present invention;

Fig. 2 is an enlarged view of a key section of the configuration of Fig. 1;

Figs 3A to 3C are cross-sectional views showing a feed pump according to Embodiment 1;

Fig. 4 is a view showing a control section of the feed pump according to Embodiment 1;

Fig. 5 is a time chart showing operations for the feed pump according to Embodiment 1;

Fig. 6 is a perspective cross-sectional view showing an automatic ice making apparatus according to Embodiment 2 of the present invention;

Fig. 7 is a perspective view showing an automatic ice making apparatus according to Embodiment 3 of the present invention;

Fig. 8 is a partial cross-sectional view showing the automatic ice making apparatus according to Embodiment 3;

Fig. 9 is a cross-sectional view showing a feed pump according to Embodiment 4 of the present invention;

Fig. 10 is a perspective view showing a water supply tank according to Embodiment 5 of the present invention;

Fig. 11 is a transverse cross-sectional view showing the water supply tank according to Embodiment 5;

Fig. 12 is a cross-sectional view showing a method of forming the water supply tank according to Embodiment 5;

Fig. 13 is a perspective view showing another example according to Embodiment 5;

Fig. 14 is a perspective view showing the automatic ice making apparatus according to Embodiment 6 of the present invention;

Fig. 15 is a cross-sectional view showing a feed pump according to Embodiment 7 of the present invention; and

Fig. 16 is a perspective view showing the inside of a casing for the feed pump according to Embodiment 7.

corner 4 provided on a partition wall 6 separating the cold chamber 2 from the freezing chamber 3, and the discharger port 68 is inserted into a water receiving section 70 monolithically formed with the water supply tank corner 4. In the water receiving section 70, an outlet port 71 monolithically formed therewith is provided so that it penetrates through the cold chamber 2 and the freezing chamber 3, and an ice making tray 27 is positioned in front of the outlet port 71. The tip of the discharge port 68 is above the maximum water level in the water supply tank 10, but under an upper edge section of the water receiving section 70.

Next, a description is made for a feed pump 69 and a section around the feed pump 69 with reference to Fig. 2. In the feed pump 69, a magnet 73, a magnetic plate 74, and an impeller 77 having a shaft 75 made from SUS 303 and a ball 76 made from SUS 304 are rotatably supported by a bearing 78 monolithically formed with the feed pump 69 with the shaft 75 inserted thereinto. The feed pump 69 has a suction port 79 in the side of the bearing, and a mesh filter 111 is attached to a tip thereof. The feed pump 69 also has a discharge port 68 of a discharge pipe in the peripheral direction of the feed pump 69. The balls 76 are fixed to a bearing side of the feed pump 69 and in the opposite side, and contact a casing of the feed pump 69.

Next, a description is made for operations with reference

to Figs. 3A to 3C, Fig. 4 and Fig. 5. Figs. 3A to 3C are views showing an operating state of the feed pump 69, and Fig. 3A is a view showing the feed pump 69 when viewed from the direction of the shaft, while Fig. 3B is a lateral cross-sectional view of a motor 72, and Fig. 3C shows magnets 73, 80 each formed into a flat plate shape with two or more poles. Fig. 4 is a general block diagram showing a control board for controlling operations of the motor 72, and Fig. 5 is a time chart showing the operations.

In Fig. 4, the reference numeral 82 indicates a control board with the motor 72 and a power supply unit 83 connected thereto and is provided in the refrigerator 1 with freezing chamber. The gear box 28 detects a quantity of ice stored in an ice storage box, and when it detects shortage of a quantity of ice, a water supply start signal is outputted from the control board 82. When a water supply start signal is outputted from the control board 82, the motor 72 is switched from the OFF state to ON state and the ON state is maintained for a specified period of time. When the motor 72 is turned ON, the magnetic plate B81 connected to the motor 72 and a magnet B80 adhered to the magnetic plate B81 start rotation. The magnet B80 and a magnet 73 in the side of the feed pump 69 form a magnetic field and attract each other with magnetism, so that the magnet B80 and the magnet 73 rotate at the same rotational speed, and also the impeller 77 with the magnet 73 attached

thereto rotates at the same rotational speed. When the impeller 77 rotates in the direction as shown in Fig. 3A, water flows out from a discharge port 68 and also water in the water supply tank 10 is sucked from the suction port 79, but in the water supply tank 10, objects each having a size of 0.4 mm x 0.4 mm or more are held on a surface of the mesh filter 111.

On the other hand, water flowing out from the discharge section 68 is supplied via a water receiving port 70 and the outlet port 71 to the ice making tray 27.

The magnets 73, 80 are formed into a flat plate shape with two or more poles as shown in Fig. 3C, and a material for the magnets is selected from ferrite-based materials or rare earth metals.

The water supply tank 10 is inserted into the water supply tank corner 4 formed into a concave section, and the construction allows insertion of the water supply tank 10 with a clearance of only several millimeters. On the other hand, in a state where the feed pump 69 has been inserted into the water supply tank 10, a position of the feed pump 69 within the water supply tank 10 is decided according to a position of a discharge port inserting position of a cover for the water supply tank, but because of attraction by magnetism, no effect is given to rotation of the pump even if a casing of the pump contacts a wall of the tank.

Namely, balls 76 are present between the impeller 77 and the

casing, and in addition, when the pump rotates, the impeller is attracted to the side of the bearing 78 due to a negative pressure generated by the pump, so that friction between the rotating bodies, namely the balls 76, and a casing which is a fixed portion is suppressed. The tank is made from plastics or non-magnetic materials such as stainless steel or glass with a thickness of 2 mm.

Also a fully large clearance is provided between a magnet 80 in the side of motor 72 and the tank to prevent them from contacting each other directly or to provide a partition wall therein. By locating ferrite magnets 73, 80 at positions opposing to each other via an entire clearance with the width of around 10 mm including backlash, a torque generated by a motor is delivered to a pump, and a user can easily dismount a tank from the concave section or remove a pump or discharge port from inside of the tank without being interfered by the magnetism.

Also the fact that a pump has been set at a specified position can be detected because the pump is magnetically attracted.

Also an area around the water supply tank can easily be cleaned after the tank including the discharge port has been taken out from the concave section.

The filter 111 is inserted into the pump with pressure, and can be cleaned after having been pulled off from the pump.

Also the pump and the discharge port can be cleaned from the inlet/outlet ports without disassembling them.

As described above, with the automatic ice making apparatus according to this embodiment of the present invention, as the feed pump 69 is installed in the water supply tank 10, a user can freely clean the feed pump 69 according to the necessity. In addition, a discharge port 68 and a water receiving section 70, an outlet port 71, and an ice making tray 27 are located as shown in the figure, so that a seal or the like is not required between the receiving port 70 and the discharge port 68.

Furthermore, the motor 72 and the feed pump 69 do not contact each other, so that a quite silent system can be constructed, and as the mesh filter 111 is attached to the suction port 79, intrusion of a foreign substance is suppressed, so that the impeller is not locked.

It should be noted that, although the water supply tank 10 is set in the water supply tank corner 4 provided in the partition wall in Embodiment 1 described above, the water supply tank corner 4 may be installed externally.

A method for mounting the water supply tank corner 4 in Embodiment 2 is different from that in Embodiment 1. In Embodiment 1, the motor 72 is located on a surface the water supply tank corner 4 in the contrary side of the water supply tank, and the water supply tank corner 4 and the partition wall 6 are formed monolithically. In this configuration, the motor

72 (generally) having a shorter service life as compared to that of the refrigerator 1 with freezing chamber can not be replaced with a new one. So a tank holder 84, in which the water supply tank corner 4 is separated from the partition wall 6, is provided, and the motor 72 fixed to a motor case 85 is attached to a rear side of the tank holder 84 as shown in Fig. 6. And, the tank holder 84 is attached to the partition wall 6 adhering a seal 86 along the entire periphery thereof. The tank holder 84 is fixed to the partition wall 6 with, for instance, screws, claws, rivets or the like which can easily be removed or used again for fixing the tank holder 84. The seal 86 should have water-tightness.

In this embodiment, as the tank holder 84 is separated from the partition wall 6, the motor 72 can easily be replaced with a new one, and in addition as the seal 86 having water-tightness is provided between the tank holder 84 and the partition wall 6, water is prevented from coming into the motor section 72.

An automatic ice making apparatus according to Embodiment 3 of the present invention is the same as those according to Embodiments 1 and 2 excluding the fact that several considerations are taken for a positional precision of the feed pump 69. In Fig. 7, the reference numeral 88 indicates a guide monolithically formed with the feed pump 69, and is engaged in a guide receiver 89 for controlling positional displacement of

the feed pump 69 in the thrust direction as well as in the radial direction shown in the figure. Also a guide 90 is provided in the water supply tank 10, and the guide 90 is engaged with the tank holder 84 or a guide receiver 91 provided in the water supply tank corner 4 for controlling positional displacement in the two directions shown in the figure. As shown in Fig. 8, the discharge port 68 of a discharge pipe from the feed pump 69 is engaged in a flange hole section 110 of the water supply tank 10.

As shown in Fig. 8, there is a cover 12 in an upper section of the water supply tank 10, and the discharge port 68 of a discharge pipe is fixed with a pressing section 12b monolithically formed with the cover 12 to control positional displacement of the feed pump 69 in the direction shown in the figure.

In this embodiment of the present invention, positional displacement of the feed pump 69 as well as of the water supply tank 10 is prevented by the guide 88 and the guide receiver for the guide 88 and the pressing section 12b provided on the cover 12, and also positional displacement of the water supply tank 10 and the tank holder guide 84 is prevented by the guide 90 and the guide receiver 91, so that positional displacement between magnets generated when the motor 72 is mounted on the tank holder 84 in Embodiment 2 can be prevented, and a driving force can accurately be delivered without stepping out.

Configuration of the automatic ice making apparatus according to Embodiment 4 of the present invention is the same as that in Embodiment 1 excluding that construction of the feed pump 69 has been changed. In Fig. 9, designated at the reference numeral 92 is an impeller cover, at 93 a cap, and at 87 a screw section monolithically formed with the feed pump 69. A shaft 75 having a flange, a ball 76, an magnetic plate 74, and a magnet 73 are attached to the impeller 77 and are completely shielded by the impeller cover 92. The impeller cover 92 is adhered to the impeller 77 and in the case where a material of the impeller cover 92 is plastic resin, it is completely welded to the impeller by means of, for instance, thermal welding. A shaft 75 of the impeller 77 having the construction as described above is inserted into the bearing 78 of the feed pump 69, and an open section in the side contrary to the bearing 78 is closed with the cap 93 and is tightened with the screw section 87.

Also when the motor 72 is driven, the impeller 77 rotates. Then, the shaft 75 and balls 76 are rotatably held by the impeller and supported by the bearing 78.

With this embodiment of the present invention, the cap 73 can freely be removed and a space inside the feed pump 69 is divided to several zones, so that, even if a foreign material comes into the feed pump 69, the foreign material can be cleaned or washed off.

Fig. 10 is a perspective appearance view showing construction of the water supply tank 10 for an automatic ice making apparatus according to Embodiment 5 of the present invention, while Fig. 11 is a cross-sectional view showing a key section thereof. Fig. 12 is a cross-sectional view illustrating a method of manufacturing a construction body according to this embodiment of the present invention. In Figs. 10 and 11, a water level display window 120 made from a transparent material is provided in the water supply tank 10, and the water level display window 120 inclining in a direction allowing visual check by a user from the front side extends to a position near a bottom section of the water supply tank 10 as shown in Fig. 11. As shown in Fig. 12, the water level display window 120 is welded to a rear side of an upper section of the water supply tank 10 by means of thermal welding, and in this

step a cover 121 is inserted between the water supply tank 10 and the water level display window 120 being engaged in a hole section of the water supply tank 10 for locking the water level display window 120. It should be noted that the welded section extends along an entire periphery of the hole section of the water supply tank 10.

The water level display window 120 may be provided in a cover section 122 formed as a separated upper section of the water supply tank 10 so that the cover can be opened or closed according to the necessity. The construction is shown in Fig. 13.

With this embodiment of the present invention, even if water drops adhere to an internal wall surface of the water supply tank 10, a border between an image of a water drop and an image of water stored in the water supply tank 10 is displayed in the water level display window 120, so that a user can accurately check a quantity of water stored in the water supply tank 10.

Fig. 14 shows a perspective appearance view showing construction of the water supply tank 10 for the automatic ice making apparatus according to Embodiment 6 of the present invention as well as of the feed pump 69 therein. An L-shaped angle 201 monolithically molded with the feed pump 69 is provided, a hole 202 is provided in the L-shaped angle 201, and the feed pump 69 is fixed to the water supply tank 10 by positioning the L-shaped angle 201 in an engaging section

between a screw cap section 203 and a screw section 206 of the water supply tank 10.

Fig. 15 shows an operating state of the feed pump 69, and Fig. 16 is a perspective appearance view illustrating inside of a casing for the feed pump 69. When the impeller 77 rotates, a liquid gathers around an external periphery thereof with air concentrated in the section indicated by an arrow mark in Fig. 16, namely at a center of the shaft 75, and when the operation is stopped, the air is concentrated in an upper section of the casing. With repetition of the operations described above, air inside the casing is not discharged and an air residing section 205 is generated. For this reason, by providing an air-vent hole 204 having a diameter, which is substantially the same as that of a discharge port, is provided in an upper section of the casing for the feed pump 69 at a position rotated from the discharge port, so that fluctuation of a water flow rate according to presence of air is eliminated and the water supply rate is stabilized.

Although the invention has been described with respect to a specific embodiment for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art which fairly fall within the basic teaching herein set forth.

Attention is directed to Application No. 9604439.1 (GB-A-2 299 657), from which this application has been divided.

The Parent Application is directed to an automatic ice making apparatus including a feed pump for pumping water to an ice making tray from a water supply tank installed in a recessed section provided in a partition wall partitioning a space of a refrigerator into a plurality of storage chambers.

Claims:-

1. An automatic ice making apparatus comprising:

a water supply tank installed in a refrigerator;

a pump installed within the water supply tank for discharging water stored in the water supply tank into an ice making tray; and

a drive unit installed outside the water supply tank, for driving the pump;

wherein the drive unit delivers torque for driving the pump in a non-contact mode.

2. An automatic ice making apparatus according to claim 1, wherein the torque is delivered by interaction of a magnet provided in the pump and a magnet provided in the drive unit at a position opposite to the magnet provided in the pump.

3. An automatic ice making apparatus according to claim 1 or 2, wherein the drive unit is attached to a tank supporting means provided on a wall of the refrigerator or in the refrigerator for mounting thereon the water supply tank and has no connection with the water supply tank through water.

4. An automatic ice making apparatus according to any preceding claim, wherein a water receiving section is provided between the water supply

tank and an ice making tray, and a discharge port of a discharge pipe connected to the pump, for discharging water into the water receiving section, is located above the maximum water level of the water supply tank as well as under an upper edge section of the water receiving section.

5. An automatic ice making apparatus according to any preceding claim, wherein a movable section of the pump is removably provided in a casing which is an enclosure for accommodating the movable section therein.

6. An automatic ice making apparatus according to any preceding claim, wherein a filter is removably provided on a pump suction port provided in the water supply tank.

7. An automatic ice making apparatus according to any preceding claim, further comprising:

tank supporting means, provided on a wall of the refrigerator or in the refrigerator, for mounting the water supply tank thereon; and

positioning means for fixing the position of the water supply tank in three directions by partially contacting the water supply tank.

8. An automatic ice making apparatus according to any preceding claim, wherein one end of a rotary shaft of a pump is rotatably supported by a pump bearing with the other end rotatably supported by an impeller.

9. An automatic ice making apparatus according to any preceding claim, wherein a water level display window enabling visual checking of the water level in the water supply tank is provided in an upper section of the water supply tank.

10. An automatic ice making apparatus according to claim 1, including positioning means for positioning in the thrust direction as well as in the radial direction provided in an L-shaped angle monolithically provided on the feed pump, and an engaging section for engaging and fixing the positioning means on the water supply tank.

11. An automatic ice making apparatus according to any of claims 1 to 5, including an air-vent hole having a diameter which is substantially the same as that of a discharge port provided in an upper section of a casing for the feed pump at a position in a rotated direction from the discharge port.

The Patent Office

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| **Application No:** | GB 9622029.8 | **Examiner:** | Mick Monk |
| **Claims searched:** | All | **Date of search:** | 16 January 1997 |

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F4H (HD7A)

Int Cl (Ed.6): F25C (1/22); F25D (23/12)

Other: ONLINE DATABASE:WPI

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | Relevant to claims |
|---|---|---|
| | NONE | |

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